Electronic Version
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Description

FLUSHING AND FILTERING SYSTEM FOR ELECTROEROSION MACHINING

BACKGROUND OF THE INVENTION

[0001] The present disclosure relates generally to electroerosion machines and, more particularly, to a flushing and filtering system for electroerosion machines.

[0002] Electroerosion machining is a process in which an electrically conductive metal workpiece is shaped by removing material through melting or vaporization by electrical sparks and arcs. The spark discharge and transient arcsare produced by applying controlled direct current between the workpiece (typically anodic or positively charged) and the tool or electrode (typically the cathode or negatively charged). The end of the electrode and the workpiece are separated by a spark gap from about 0.01 millimeters to about 0.50 millimeters, and are immersed in or flooded by a dielectric fluid or an electrolyte fluid. The fluid in the gap is partially ionized under the DC volt-

age (pulsed or continuous), thus enabling a spark discharge or transient arc to pass between the tool and the workpiece. Each spark and/or arc produces enough heat to melt or vaporize a small quantity of the workpiece, thereby leaving a tiny pit or crater in the work surface.

[0003] Electroerosion machining is also non-contact or minimum-contact machining process that can quickly shape any electrically conductive material regardless of the hardness or toughness of the material. In the electroerosion process, a substantial amount of material is removed from the metal workpiece. Metal chips are deposited at the bottom of a working tank and subsequently rolled by high pressure flushing. Without adequate filtration, these rolled chips can be pumped back into the machining zone and generate secondary discharge or arcingbetween the electrode and the workpiece,thereby affecting process stability and surface integrity as well as geometry accuracy.

[0004] At present, existing EDM-type filtration and flushing systems that are adopted for electroerosion machines do not have sufficient filtration systems associated therewith.

Brief Description of the Invention

[0005] The above discussed and other drawbacks and deficien-

cies of the prior art are overcome or alleviated by a flushing and filtering system for an electroerosion machine. In an exemplary embodiment, the system includes a work tank configured to maintain a workpiece therein, a first filtering stage for roughly filtering residue-containing machining liquid exiting from the work tank, and a second filtering stage for finely filtering roughly-filtered machining liquid exiting from the first filtering stage.

[0006] In another aspect, a method for flushing and filtering an electroerosion machine includes passing a residue-containing machining liquid through a first filtering stage for roughly filtering the residue-containing machining liquid. The residue-containing liquid exits from a work tank configured to maintain a workpiece therein. The roughly-filtered machining liquid exiting from the first filtering stage is passed into a second filtering stage for fine filtering of the roughly-filtered machining liquid.

Brief Description of the Drawings

[0007] Referring to the exemplary drawings wherein like elements are numbered alike in the several Figures:

[0008] Figure 1 is schematic diagram of a flushing and filtering system suitable for use with electroerosion machines, in accordance with an embodiment of the invention; and

[0009] Figure 2 is schematic diagram of and alternative embodiment of the flushing and filtering system shown in Figure 1.

Detailed Description of the Invention

[0010] Disclosed herein is a novel flushing and filtering system for electroerosion machines, in which two separate filtering stages ("rough" and "fine") are implemented. Each filtering stage has a separate filtering tank associated therewith, and a pump to transfer the roughly filtered machining fluid to the fine filtering tank from the rough filtering tank. Moreover, the fine filtered stage further features two fluid return paths, including an additional fluid adding pump in addition to a high-pressure pump for fluid return directly to the tool itself.

[0011] Referring now to Figure 1, there is shown a schematic diagram of a flushing and filtering system 100 suitable for use for electroerosion machines, in accordance with an embodiment of the invention. As is shown, a work tank 102 contains workpiece 104 that is to be milled, shaped or otherwise machined by an electroerosion process. To this end, an electrode 106 is configured in close proximity to the workpiece 104 through a guide bush 108. As is known in the art, the electrode 106 has a machining liquid

110 continuously circulated at high pressure therethrough and introduced into a gap between the electrode 106 and the workpiece 104 for facilitating the machining operation.

[0012] In addition to being circulated through the electrode center, the machining liquid 110 is also supplied to the guide bush for exterior flushing of contaminants. A liquid adding inlet 112 at the lower portion of the work tank 102 receives machining liquid 110 from a separate input path from that supplying the electrode 106 and guide bush 108, as described in greater detail hereinafter. Sufficient machining liquid 110 is introduced into the work tank 102 to as to maintain the workpiece 104 and guide bush 108 in a substantially submerged condition during the machining process. In an alternative embodiment depicted in Figure 2, a liquid adding outlet/nozzle 113 is configured proximate the top of the work tank 102 for receiving machining liquid 110 and spraying or flushing the machining liquid 110 to the machining area from an up-down or side-to-side direction between the workpiece 104 and electrode 106. In other words, in lieu of being submerged in machining liquid 110, the nozzle may be used to spray the exterior of the guide bush 108 and the workpiece

104.

[0013] In either case, the residue-containing machining liquid 110 exits the bottom of the work tank 102 from outlet 114, and is directed to a first (rough) filtering stage, generally designated at 116. In order to facilitate the sweeping away of metallic chip residue, the bottom of the work tank 102 may be downwardly sloped or inclined toward outlet 114. The first filtering stage 116 includes a first (rough) filtering tank 118, rough filtering device 120 and a rough filtering pump 122 for transferring the resulting roughly filtered machining liquid 110 to a second (fine) filtering stage 124.

[0014] The second filtering stage 124 includes a second (fine) filtering tank 126 in which there is included a fine filtering device 128 for receiving the roughly filtered machining liquid 110 from the first filtering stage 116. Two separate exit fluid return paths are used to transfer the resulting finely filtered machining liquid back through the tool electrode 106 and into the work tank 102. A first fluid return path is a high-pressure fluid path 130 that includes a high-pressure pump 132 and optional pressure sensor 134 for circulating the finely filtered machining liquid 110 through the electrode 106 and to the guide bush 108. A

second fluid return path 136 includes a liquid adding pump 138 that supplies finely filtered machining liquid 110 through the liquid adding inlet 112 at the lower portion of the work tank 102.

[0015] In operation of the flushing and filtering system 100, the liquid adding pump 138 is turned on to add finely filtered machining fluid (e.g., dielectric, electrolyte) into the work tank 102. When both the workpiece 104 and the guide bush 108 are submerged into the machining fluid 110, the high pressure pump 132 is turned on, and the normal electroerosion machining cycle starts. At the same time, the outlet 114 is opened while the rough filtering pump 122 between the rough and fine filtering tanks is turned on, causing the system 100 to begin the flushing and filtering cycle. During machining of the workpiece 104, the resulting metallic chips are swept away from the workpiece 104 and out of the work tank 102 due to the sloped bottom surface of the work tank 102 and continuous addition of machining fluid 110 through at least two different fluid paths. This also helps to ensure each workpiece is machined under the same conditions, as well as to reduce secondary discharge by the chips. Thus, both process stability and part quality is improved.

[0016] While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.